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(71) Applicant: HOLZMANN SIV ANNA ELEONORA
Marövägen 9
S-182 45 Enebyberg(SE)

(72) Inventor: Holzmann, Peter
Marövägen 9
S-182 45 Enebyberg(SE)

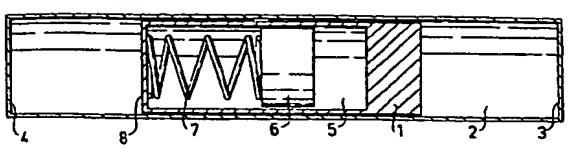
(74) Representative: Svanfeldt, Hans-Ake
Erik Lindquist Patentbyra AB P.O. Box 5386
S-102 46 Stockholm(SE)

(54) A recoil damper.

(57) A recoil damper for a percussion tool (1) which is movable to-and-fro between an impact face (3) and a recoil receiving face (4) and which is driven against the impact face so as to deliver its kinetic energy by impact effect to the impact face.

The invention is characterized by having at least one additional mass (6) which is movable in relation to the percussion tool (1) and which is connected to the percussion tool by at least one resilient member (7), the resiliency of the resilient member being chosen so that the kinetic energy of the mass (6) cooperates with that of the percussion tool at the impact of the percussion tool against the impact face (3) while the kinetic energy of the mass (6) is directed opposite to that of the percussion tool at the impact of the percussion tool against the recoil receiving face (4). By this arrangement the recoil force performs a useful work in that the recoil force is turned at the impact of the percussion tool against the recoil receiving face and contributes to setting the mass (6) into operation which coincides with that of the percussion tool when the last-mentioned strikes against the impact face (3). By that the operating force of the percussion tool is improved.

Fig. 1



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A Recoil Damper

The present invention relates to a recoil damper, i.e. a device which reduces the impact force of a percussion tool against a recoil receiving face.

In machines and implements of the kind which contains a percussion tool which is movable to-and-fro between an impact face and a recoil receiving face and which is driven against the impact face so as to deliver kinetic energy by impact effect to the impact face, energy is released not only at the impact against the impact face but also at the impact against the recoil receiving face. In other words, useful work is carried out only at the impact against the impact face, and accordingly the efficiency is at the most 50%. The force which is released at the impact against the recoil receiving face creates vibrations or bumps in the machine or implement, respectively. Usually the recoil force is taken up in separate fastening means which are subjected to great stresses. In the case of hand-held implements the recoil forces are taken up in the body tissues of the tool operator which involves risks of damage to his health. Industrial injuries of this kind are well-known in work medicine, and lately an extensive work is going on which aims at limiting the allowable exposure to vibrations and bumps which act on the whole body or only on certain parts thereof, for example the hands.

A prior method of reducing the impact force of the percussion tool against the recoil receiving face is that the movement of the percussion tool in the recoil direction is caught by resilient means, for example a spring, an air cushion or the like. By this means the released recoil force may be distributed over a longer time, whereby the impact effect is cushioned. It is known to isolate the whole machine by resilient suspension means, which prevents the recoil forces from being transferred to the fastenings of the machine or to handles by means of which the machine or tool is held. In all the cases, however, the machine performs an equal work in both directions and the recoil force is regarded as an unavoidable and energy consuming secondary effect of the work carried out. However, a good resilient suspension of the machine/tool also reduces the possibilities of controlling the machine/tool with precision.

The invention aims at making use of the recoil force and turning it so that it will perform useful work in the working direction of the percussion tool. Accordingly, the novelty resides in the recoil force being conceived as a resource.

The characteristic feature of the invention is at least one additional mass which is movable in relation to the percussion tool and which is connected to the percussion tool by at least one resilient member, the resiliency of the resilient member being chosen so that the kinetic energy of the mass cooperates with that of the percussion tool at the impact of the percussion tool against the impact face while the kinetic energy of the mass is directed opposite to that of the percussion tool at the impact of the percussion tool against the recoil receiving face.

According to the invention, as the resilient member there may be used, for example, a helical spring, a gas or air

cushion or valve-controlled compressed air. According to a preferred embodiment of the invention the percussion tool consists of a cylindrical piston having an axial boring into which the mass is inserted.

Various embodiments of the invention will be described more closely below in connection with the attached drawings, in which:-

Figure 1 shows a first embodiment of the recoil damper according to the invention,
Figure 2 shows another embodiment of the recoil damper according to the invention, and
Figure 3 shows a modified embodiment of the recoil damper according to the invention shown in Figure 2.

Figure 1 illustrates the basic idea behind the invention. A percussion tool 1 is movable to-and-fro in a cylindrical housing 2 having an impact face 3 and a recoil receiving face 4. The percussion tool 1 is driven against the impact face 3, for example by means of compressed air, magnetic forces or corresponding means. The drives are conventional and, therefore, are not shown in detail. When the percussion tool moves to the right in Figure 1, it is said to move in the working direction, while it is said to move in the recoil direction when it moves to the left. An axial boring 5 is made in the percussion tool 1, and in this axial boring 5 a recoil damping mass 6 according to the invention is introduced. A spring member 7 in the form of a compression spring connects the mass 6 with the percussion tool 1. One end of the spring 7 is fixed to the part of the mass 6 which is turned towards the recoil receiving face 4, while the other end of the spring is fixed to the end of the percussion tool 1 which is turned towards the recoil receiving face 4. Possibly, the axial boring 5 may also be covered with a cap 8.

In Figure 1 the percussion tool 1 strikes both the impact

face 3 and the recoil receiving face 4 unresiliently. Immediately after the impact against the face 4 the percussion tool 1 is thrown back in the opposite direction, the mass 6, however, continuing to move in the recoil direction, compressing the spring 7. The recoil force at the moment of impact is thus determined by the speed and the mass of the percussion tool 1 (provided that the spring-tension of the spring 7 is small). When the kinetic energy of the mass 6 has compressed the spring 7 at an optimum the mass 6 is thrown back by the spring 7 in the working direction, the mass 6 and the percussion tool 1 both now moving in the working direction. After a possible addition of driving force both masses 1 and 6 move to the right until impacting against the impact face 3. The spring force of the spring 7 is dimensioned so that the direction of the kinetic energy of the two masses 1 and 6 coincides when the percussion tool 1 strikes the impact face 3 unresiliently.

Figure 2 shows a modified embodiment of the recoil damper according to the invention. The percussion tool is here braked gently at the impact against the recoil receiving face 4 by means of an additional compression spring 9 provided between the recoil receiving face 4 and the cap 8 or corresponding means. Another additional compression spring 10 is provided between the part of the mass 6 which is turned towards the impact face 3 and the bottom 11 of the boring 5. The resilient properties of the springs 7, 9 and 10 are adapted so that the mass 6 performs oscillatory movements of such frequency that the units 6 and 1 have the same direction and turn back simultaneously at the impact against the impact face 3, whereby the kinetic energies of these parts coact during performance of useful work, while the kinetic energies of the parts 1 and 6 counteract each other at the impact against the recoil receiving face 4. During the movement of the percussion tool 1 in the direction of movement the mass 6 may carry out one or more oscillations. It is seen that at the impact of the

percussion tool 1 against the impact face 3 kinetic energy is released which is determined by the speeds and masses of the units 1 and 6. The efficiency of the device as a whole is accordingly increased.

Figure 3 shows a modification of the recoil damper shown in Figure 2. A striking pin 12 extends through an opening 13 which is made centrally in the end of the percussion tool 1 which is turned towards the impact face 3. A weak spring 14 pre-stresses the striking pin 12, so that this pin projects beyond the impact face of the percussion tool 1 which is turned towards the impact face 3. When the percussion tool 1 approaches the impact face 3 in the working direction the striking pin 12 is pressed inwards, towards the mass 6. All the springs have been dimensioned so that the mass 6 will engage the striking pin 12 at the same time as the percussion tool 1 engages the impact face 3. Furthermore, the mass 6 is to come into contact with the striking pin 13 when the mass 6 has got its maximum kinetic energy. When the percussion tool 1 turns back when impacting against the recoil receiving face 4 the impact against this face is damped by the mass 6 having an opposite phase of movement, i.e. by continuing to move in the recoil direction at the same time as the additional recoil spring 9 contributes to damping the impact in the recoil direction.

The percussion tool 1 and the mass 6 may be made of metal, plastic or other materials, while the springs 7, 9, 10 may consist of helical springs of metal, elastic material, gas or liquid cushions, or valve-controlled compressed air.

According to the invention the percussion tool 1 may be divided into two or more masses. Also the mass 6 may be divided into two or more masses.

The embodiments of the invention described above may be modified and varied in many ways within the frame of the basic idea of the invention.

Claims:

1. A recoil damper for a percussion tool (1) which is movable to-and-fro between an impact face (3) and a recoil receiving face (4) and which is driven against the impact face so as to deliver its kinetic energy by impact effect to the impact face, characterized by at least one additional mass (6) which is movable in relation to the percussion tool (1) and which is connected to the percussion tool by at least one resilient member (7), the resiliency of the resilient member being chosen so that the kinetic energy of the mass (6) cooperates with that of the percussion tool at the impact of the percussion tool against the impact face (3) while the kinetic energy of the mass (6) is directed opposite to that of the percussion tool at the impact of the percussion tool against the recoil receiving face (4).

2. A recoil damper according to claim 1, characterized by the fact that the mass (6) is connected with the percussion tool (1) by means of two spring members, one on either side of the mass (6).

3. A recoil damper according to claim 2, characterized by an additional spring member (9) disposed between the recoil receiving face (4) and the percussion tool (1).

4. A recoil damper according to claim 3, characterized by a striking pin (12) mounted movable in the percussion tool and projecting beyond the percussion tool towards the impact face (3) so as, before the percussion tool strikes the impact face, to be moved, by contact against the impact face, towards the mass (6), the length of the striking pin being adapted so that the striking pin at the impact of the percussion tool (1) against the impact face (3) strikes the mass (6) at the same time as the mass has its maximum kinetic energy.

5. A recoil damper according to any of the preceding claims, characterized by the fact that the percussion tool (1) is a cylindrical piston having an axial boring (5) into which the mass (6) is introduced.

6. A recoil damper according to any of the preceding claims, characterized by the fact that the resilient member (7) and said additional resilient member (9, 10) is a compression spring, a gas, air or liquid cushion, or valve-controlled compressed air.

7. A recoil damper according to claim 4, characterized by a spring (14) for pre-tensioning the striking pin (12) against the impact face (3).

Fig.1

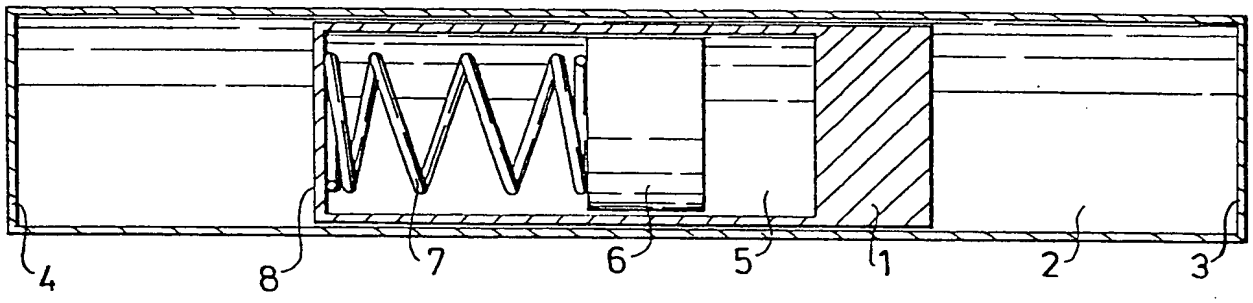


Fig.2

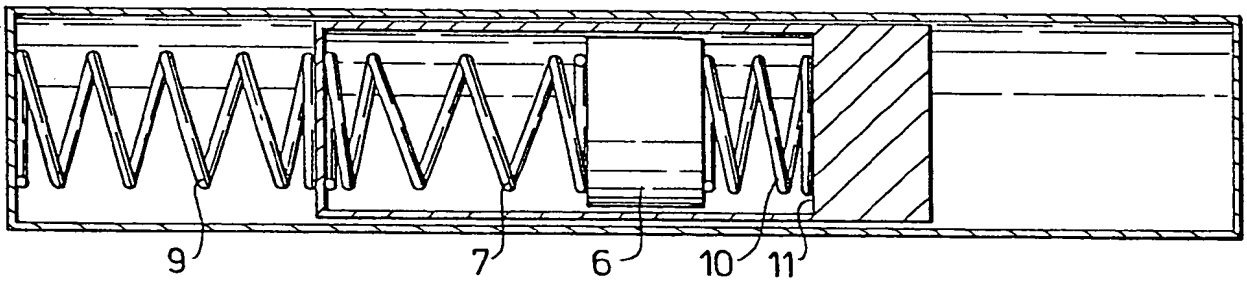
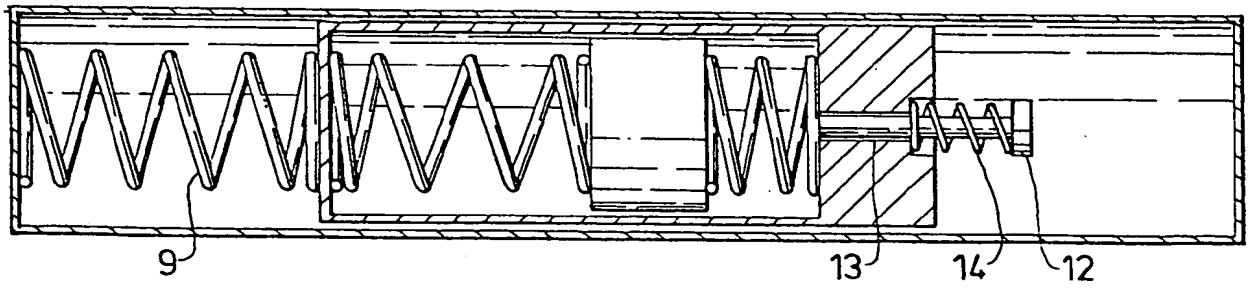


Fig.3



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EUROPEAN SEARCH REPORT

Application number

EP 81 85 0038.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	DE - A1 - 2 727 639 (HILTI AG) * claims 1 to 5; fig. 1 to 3 *	1,5
	DE - U1 - 7 719 277 (HILTI AG) * claims 1 to 5; fig. 2 *	1,5,6
	DE - B - 1 281 970 (DEUTSCHE REICHSBAHN) * column 4, line 57 to column 5, line 5; fig. *	1,6
	DE - C - 1 011 819 (GOETZEWERKE AG) * column 2, line 47 to column 3, line 3; fig. *	1,3, 5,6

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

B 25 D 17/24

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

B 25 D 17/24
F 16 F 7/10

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons
&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	03-06-1981	HOFFMANN

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